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GLAUBERITE CRYSTAL-CAVITIES IN THE TRIASSIC ROCKS OF EASTERN PENNSYLVANIA [1]

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AT A number of places in eastern Pennsylvania the Triassic rocks contain numerous cavities, or calcite pseudomorphs, which show by their angular form that they were originally occupied by a crystalline mineral. Study of specimens of these has demonstrated the original mineral to have been glauberite, $Na_2Ca(SO_4)_2$. Similar pseudomorphs in shale from Princeton, and cavities in the zeolite deposits of the First Watchung Mountain, in New Jersey, are believed to represent the same mineral. A preliminary announcement of these conclusions has already been made,[2] but in the present paper the Pennsylvania occurrences are described in greater detail.

Altho these crystal cavities occur at a number of widely separated localities, they are particularly well developed one mile south of Steinsburg, Bucks County. The rocks here exposed comprise gray, green, and dull red shale and argillaceous sandstone. To some extent in all of these rock types, but in especial abundance in the dull red sandy beds, there appear numerous cavities, singly and in groups, and lozenge-shaped in cross section. They vary in outline from tabular to elongated-pyramidal, the pyramid edge attaining a maximum length of five centimeters, and show no definite orientation in the bed. A photograph of a specimen[3] of the rock containing a number of these cavities is shown in the frontispiece, Plate III.

The shape of the cavities shows clearly that they are molds of crystals of some soluble salt, which must have crystallized in the mud while it was still soft, but remained intact until it had become thoroly hardened. While this locality was discovered in 1909 by Mr. George W. Geist of Philadelphia, and the writer (then instructor in mineralogy at Lehigh University, South Bethlehem, Pa.), no opportunity to study the specimens critically was found until 1915. During the summer of that year, however, an effort was made to determine the nature of the mineral from the shape of the cavities, as part of the writer's research work at the National Museum.

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[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] *J. Wash. Acad. Sci.*, **6**, 181–184, 1916.

[3] U. S. National Museum Cat. No. 92931.

Some of the cavities were broken open lengthwise, and plaster casts of them prepared. Comparison of these with various saline minerals showed that the original mineral was undoubtedly glauberite, the double sulfate of sodium and calcium, $Na_2Ca(SO_4)_2$. The distribution of faces indicates the mineral to have been monoclinic, with forms that may be described as a basal pinacoid, a pyramid with strongly striated and often convex or concave surfaces, and a prism. The angles, measured with a contact goniometer, compared with those of natural crystals, are given in Table I.

TABLE I. ANGLES MEASURED ON CASTS AND NATURAL CRYSTALS OF GLAUBERITE

Forms	*Casts of cavities in shale, Steinsburg, Pa.*	*Glauberite crystals, California*	*Forms and theoretical angles*	
			001 ∧ 334	36°41′
Base ∧ pyramid	36–43°	38–43°	001 ∧ 445	38° 7′
			001 ∧ 111	43° 2′
			334 ∧ 334	55° 2′
Pyramid ∧ pyramid	54–64°	57–64°	445 ∧ 445	57° 2′
			111 ∧ 111	63°42′
Prism ∧ prism	96–98°	97°	110 ∧ 110	96°58′

The variations in the above angles are due to the curvature of the faces, which renders exact measurement impossible. The pyramid faces are actually composed of three forms, in oscillatory combination with one another, as shown by the striations, and only in rare cases does one of these forms stand out individually. The agreement between the angles of the casts and natural crystals is, however, noteworthy. And the similarity extends further: the habit, mode of intergrowth, and striations of these casts are like those of the natural glauberite from California, as brought out in Figure 1, the three in the upper row being plaster casts of cavities in the specimen, while the three in the second row are natural crystals.[4] In both casts and crystals the base is dominant, a pyramid well developed, and the prism small. From the base of both occasionally project smaller crystals intergrown with the larger ones in sub-parallel position. And, most striking of all, the pyramid faces of both are horizontally striated by oscillatory combination with the base or another pyramid. The identity of the mineral which formed the cavities with glauberite may therefore be regarded as established.[5]

In addition to the typical crystal forms shown by the majority of the cavities, as above described, certain peculiar types of crystals are occasionally found. The most important of these is the long-pyramidal type, a good example of which is illustrated in the center of the bottom row on Figure 1.[6] Altho crystals of this habit are not known to occur at the California locality, they have been reported from other places. Groth[7] mentioned that the reddish colored glauberite from Iquique, Peru, in the Strassburg mineral collection, is in very long slender prisms after the pyramid (111). Dana[8] stated that the mineral may be prismatic by extension of the same form. And among the duplicate minerals in the National Museum collection there was found a single crystal, labeled Clear Lake (?), California (but without catalog number or any statement as to its history), which has the pyramid faces greatly elongated and tapering.

In most cases the crystal cavities have sharp edges, indicating that no solution took place before the hardening of the enclosing mud. In certain layers of the rock, however, the glauberite had begun to dissolve before the mud surrounded it, the faces being deeply corroded. A cast of one of these[9] is figured in the lower left hand corner of Figure 1.

In another road cut, about one half mile southwest of the one yielding all of the cavities thus far described, which may be known

[4] U. S. N. M. Cat. Nos. 47556 and 84006.

[5] When the preliminary announcement (*loc. cit*, note 2) appeared, Prof. J. Volney Lewis informed the writer that he had been studying for some time similar cavities in Triassic shale from the Gettysburg, Pa., region, collected by Mr. George W. Stose, and had decided that they represented glauberite. The fact that we reached the same conclusion independently may be regarded as final proof of its validity.

[6] U. S. N. M. Cat. No. 92962.

[7] *Min. Samml. Univ. Strassburg*, 155, 1878.

[8] *System of Mineralogy*, Ed. 6, 899, 1892.

[9] U. S. N. M. Cat. No. 92962.

as the Spinnerstown locality, since it lies one half mile northeast from that place, the strata contain instead of cavities numerous pseudomorphs of calcite after glauberite. The crystal outlines are usually somewhat less distinct than those of the cavities, yet there can be no question that they represent the same mineral, as will be seen from the photograph of one of them[10], in the lower right hand corner of Figure 1. The calcite is minutely granular, showing no cleavage faces to the naked eye, although in thin section under the microscope it has all the properties of calcite. Its pseudomorphic character is proved by this structure, for if it had filled an open cavity it would probably have been much more coarsely crystalline.

Similar cavities and calcite pseudomorphs, tho mostly less well developed, are found at a large number of localities in the same general region. At times they are large and rounded, again sharp but very minute and scattered thru the rock in enormous number. They appear to occur thruout the 10,000 feet of beds in the Brunswick formation, altho if anything they are more abundant in the upper portion.

In the Lockatong or Gwynedd formation which underlies the Brunswick, differing in the greater hardness and darker colors of the beds, Mr. A. C. Hawkins [11] noted the occurrence of pseudomorphs of calcite and analcite after a mineral which he did not identify, but which was later suggested by the writer to be glauberite. A visit to the localities described by Mr. Hawkins,—quarries in the eastern part of Princeton, New Jersey, and one near Mt. Eyre, southeast of Dolington, Pa.,—in company with Dr. Schaller of the U. S. Geological Survey, yielded abundant evidence of the correctness of this view, in that the pseudomorphs showed the same forms as those in the Brunswick formation, differing only in their more elongated habit; crystals as much as 10 cm. long but only 2 mm. in diameter were noted. The waters from which the Lockatong beds were deposited apparently contained considerable silica (colloidal) and this may possibly have been the cause of the unusual crystal habit. The Stockton or Norristown formation, which underlies the Lockatong, and is the lowest member of the Triassic of the region, has not been observed to contain glauberite, but it consists largely of feldspathic sandstone and conglomerate, and was probably not formed under conditions favorable to the crystallization of saline minerals.

[10] U. S. N. M. Cat. No. 92962.

[11] *Ann. N. Y. Acad. Sci.*, **23**, 163, 1914.

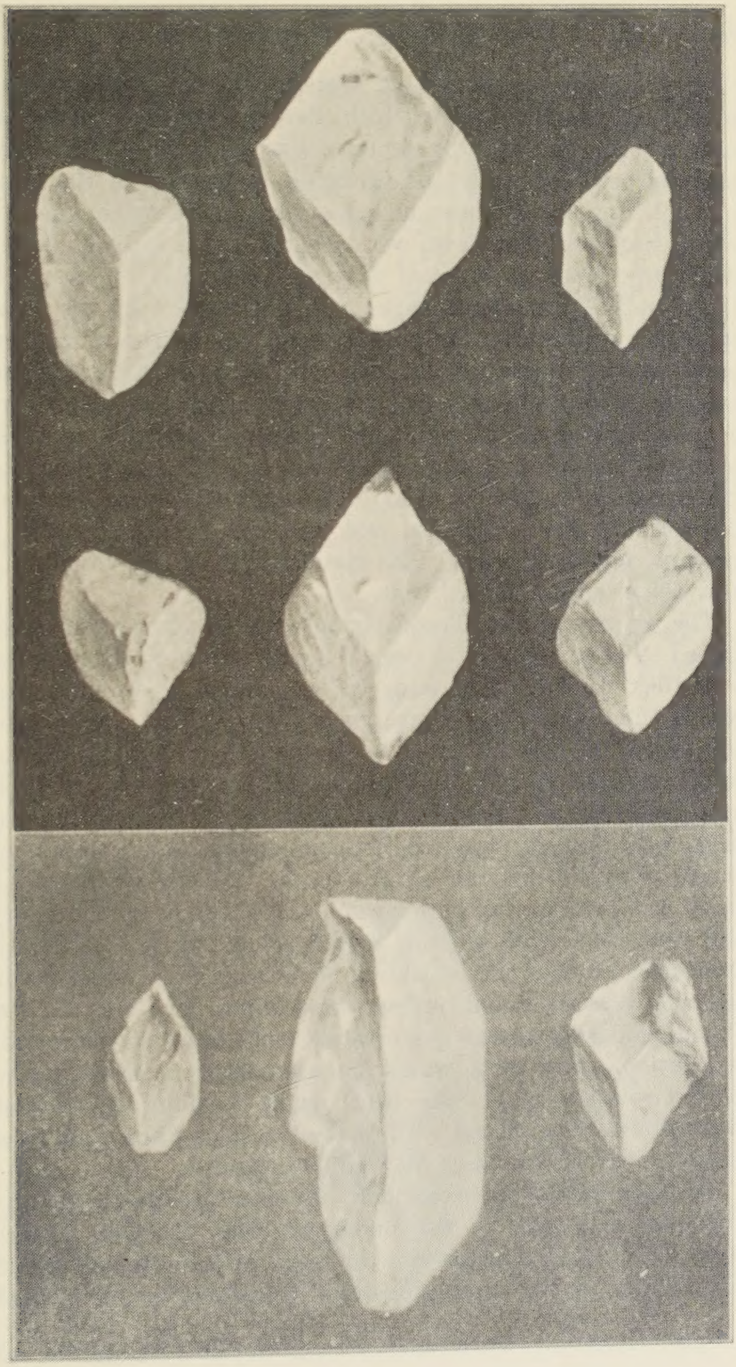

FIGURE 1.—GLAUBERITE CASTS, CRYSTALS AND PSEUDOMORPH

The Triassic or Newark of eastern North America exhibits many peculiar phenomena which, though long unexplained, are now being interpreted by geologists as the results of the continental, and especially the fluviatile, deposition of the strata under a climate of greater or less aridity.[12] That the waters in which they were laid down were shallow and repeatedly became dried up—conditions typical of river flood-plains—is shown by the abundance of ripple marks and mud cracks; by the bright red color of most of the rocks, indicative of thoro aëration; by the frequent presence of calcite, in nodules or scattered grains; and by various other lines of evidence. Here and there thruout the red beds occur lens-shaped bodies of green, gray, or black rocks, owing their colors to the presence of carbon and of ferrous-iron minerals. These beds were evidently formed under conditions of less thoro aëration, and were no doubt deposited in swamps, ponds, or lakes. The glauberite is usually found in or near these darker colored beds.

The genesis of the Triassic glauberite is accordingly interpreted to have been as follows: When the Triassic rivers spread over their floodplains, forming lakes, puddles, or swamps, from which the water rapidly evaporated, any saline constituents present in the water would of course crystallize out. The waters of many existing rivers are characterized by the presence of the ions of sulfuric acid, calcium, and sodium, and the same may well have been true of those of Triassic times; these constituents would crystallize together as glauberite. When a small body of water was formed, evaporation would occur with especial rapidity, and numerous small crystals would result; when a large lake developed, so that crystallization could take place more gradually, the crystals would be fewer in number, but larger in size. When mud surrounded the crystals and protected them from re-solution, their form would be accurately preserved; when partial solution could take place owing to dilution cavernous faces would be produced. All of the features of the occurrences above described can thus be readily explained.

Whether the calcite occasionally found as pseudomorphs after the glauberite crystals was deposited from the same Triassic lakes, or whether it represents the result of the action of ground waters carrying carbon dioxide upon the glauberite long after the hardening of the beds into rock can not be definitely decided from the evidence at hand, but the latter explanation seems the more reasonable. The widespread occurrence of glauberite cavities (and pseudomorphs) shows that conditions of aridity must have prevailed thruout the deposition of the greater part of the Triassic beds of this region.

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[12] See, for instance, Pirsson and Schuchert, *Text-book of Geology*, 814, 1915.

It may be noted in passing that halite rather than glauberite is represented by crystal cavities and pseudomorphs in the New England Triassic. Thus at Wilbraham and Holyoke, Massachusetts, the sediments contain cubical cavities and impressions of skeleton cubes, originally occupied by halite.[13] At West Springfield occur calcite replacements of skeleton crystals which have been regarded by various writers as such widely different minerals as chiastolite, spinel, and octahedrite, but were shown by Professor Emerson to be pseudomorphs after halite.[14] Evidently the waters of Triassic rivers in that region differed in composition from those in what is now Pennsylvania and New Jersey; or perhaps the ocean was nearer, and sodium chloride was carried inland as spray. At any rate, aridity sufficient to develop saline minerals also characterized Triassic climate there.

The cavities in the zeolite deposits of the First Watchung Mountain, New Jersey, will be described in detail by Dr. W. T. Schaller of the U. S. Geological Survey, and nothing will here be added to what has been stated in the preliminary paper cited above. The evidence that these cavities, too, represent glauberite seems convincing.

[13] Emerson, *Bull. U. S. Geol. Survey,* **126,** 144–145, 1895.

[14] *Ibid.,* 144–147; also *Bull. Geol. Soc. Amer.,* **6,** 473, 1894.

A NEW OCCURRENCE OF STEVENSITE, A MAGNESIUM-BEARING ALTERATION PRODUCT OF PECTOLITE

M. L. GLENN
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In the old Hartshorn quarry, in Springfield Township, Essex County, New Jersey, Mr. Louis Reamer of Short Hills, N. J., discovered a single vein of a peculiar mineral, called by the quarrymen "magnesium" (=talc?) and submitted samples of it to the writer for identification. It proved to be essentially identical with the hitherto imperfectly known *stevensite*, the nature of which is discussed in this article. The quarry lies some 16 miles southwest from the better known mineral localities around Paterson, but is in the same rock, the basalt of First Watchung Mountain. The rock is, if anything, more altered than that at Paterson, and the mineralogical association is somewhat different from that at the latter place. The most unusual feature is the abundance of a secondary feldspar, in aggregates of sheaf-like and "cocks-comb" crystals, which shows the optical properties of anorthoclase.[1] There are also numerous small quartz crystals, usually iron-stained; drusy prehnite in small pockets; many calcite crystals; a little pectolite and datolite; and several zeolites. Of the latter natrolite, stilbite and heulandite were the only ones noted by the writer, no trace of apophyllite, chabazite, or laumontite, so common at other similar localities, being observed.

Some of the pectolite found at the quarry is of the usual type, silky radiations of fine needles, but the greater part of it shows marked evidence of alteration, the color becoming more and more pinkish and the luster more and more waxy toward the outer ends of the radiations. The properties of the most altered material are as follows:

Color, white to pink (colored by manganese); luster waxy; translucent; structure compact, though with occasional shrinkage cracks; brittle; fracture hackly; feel smooth; hardness 2.5; specific gravity varying from 2.15 to 2.20; optical properties:[2] chiefly isotropic and amorphous, and showing very few feebly doubly-refracting areas (metacolloidal, cryptocrystalline); index of refraction about 1.50, but varying slightly from one fragment to another, owing to differences in water content.

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[1] As determined by Dr. Edgar T. Wherry.

[2] Also determined by Dr. Wherry.

Qualitative tests: Before the blowpipe fuses at 3 to a white enamel; in a dark room shows beautiful bluish green luminescence. In closed tube decrepitates, gives off neutral water, and becomes gray. In HCl dissolves, forming granular SiO_2, and the solution yields reactions for Mg. In H_2O some pieces crumble and give off air bubbles with a crackling sound.

Chemical composition: The analyses recorded below were made on material from which a little calcite had been removed by hand-picking.

TABLE I. COMPOSITIONS OF MAGNESIUM-BEARING PECTOLITES

	1	2	3	4	5	6	7	8
H_2O	2.70	5.26	4.09	5.28	5.53	6.76	8.45	9.04
Na_2O	9.31	9.06	8.57	6.50	6.89	5.59	3.73	....
K_2O	....	....	....	0.85	0.21	....	....	....
CaO	33.68	32.80	32.21	28.64	24.72	22.59	1.61	....
MgO	....	....	1.43	5.12	5.76	9.81	27.66	30.37
MnO	....	....	....	....	....	0.13	0.03	....
FeO	....	....	tr.	1.33	....	....	....	....
$Al_2O_3+Fe_2O_3$	....	....	0.58	....	0.67	1.18	0.37	....
SiO_2	54.31	52.88	53.94	52.20	56.22	53.84	58.03	60.59
	100.00	100.00	100.82	99.92	100.00	99.90	99.88	100.00

To bring out the variations in the percentages of the constituents the above analyses are arranged, not in the usual order, with new ones first, but in such manner that the new ones fall in columns 6 and 7, thus:

1. Theoretical composition of ordinary pectolite, $HNaCa_2(SiO_3)_3$.
2. Theoretical composition of a monohydrate of the preceding, $HNaCa_2(SiO_3)_3+H_2O$.
3. Analysis of massive pectolite, Point Barrow, Alaska.[3]
4. Analysis of "walkerite" from Corstophine Hill, Scotland.[4]
5. Analysis of "magnesiumpektolith" from Burg, Herborn, Germany.[5]
6. Analysis by the writer of partially altered pectolite from the Hartshorn quarry.
7. Analysis by the writer of highly altered pectolite, same locality.
8. Theoretical composition of the pure magnesium mineral, "stevensite," the monohydrate of talc, $H_2Mg_3(SiO_3)_4+H_2O$.

The mineral of No. 6 retained the pectolite structure, but showed impregnation by waxy material; while that of No. 7 was the purest waxy mineral obtainable, and appeared to be essentially homogeneous, altho a few fibers of unaltered pectolite no doubt remained, giving rise to the Na_2O and CaO content found. Analyses were made on material dried at 110°.

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[3] F. W. Clarke, *Am. J. Sci.* [3], **28,** 20, 1884.

[4] Heddle, *Mineralog. Mag.*, **4,** 121, 1880.

[5] E. Reuning, *Centr. Min. Geol.*, **1907,** 739.

From these analyses, which represent pectolites which have undergone successively greater alteration by magnesium-bearing solutions, it appears that:

1. Magnesium replaces both calcium and sodium.
2. As the magnesium content increases the water, and in some cases the silica also, increases.

The end product toward which the material here analyzed is evidently tending is therefore a mineral with the ratios of talc but containing an additional molecule of water, of which the theoretical composition is shown in the last column of Table I. Its amorphous, colloidal character readily accounts for this extra water as the colloid forms of almost every substance contain more water than the corresponding crystalline ones. This end product may be regarded as a mineral species because it has certain characteristic physical properties, as described above; it appears homogeneous under the microscope; and the composition indicated for it seems reasonable.

The name stevensite, given to "talc pseudomorphous after pectolite" by A. R. Leeds in 1889,[6] seems appropriate for it; materials thus labeled in various collections agreeing with it in properties.

As to its origin, rain water probably first extracted magnesium from the basalt rock as bicarbonate, and the resulting solution reacted with pectolite somewhat as follows:

$$\underset{\text{Pectolite}}{4HNaCa_2(SiO_3)_3} + \underset{\substack{\text{magnesium}\\ \text{bicarbonate}}}{9MgH_2(CO_3)_2} + \underset{\text{water}}{3H_2O} =$$

$$\underset{\text{stevensite}}{3[H_2Mg_3(SiO_3)_4.H_2O]} + \underbrace{\underset{\substack{\text{calcium}\\ \text{bicarbonate}}}{8CaH_2(CO_3)_2} + \underset{\substack{\text{sodium}\\ \text{carbonate}}}{2Na_2CO_3}}_{\text{removed in solution}}.$$

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[6] *Nat. Leisure Hour,* **12,** 31, 1889; thru Chester, *Dict. Names Minerals,* Ed. 1, 257, 1896.

THE PHYSICO-CHEMICAL VIEW

REPRINTED by permission from the program of the 1916 banquet of the Pick and Hammer Society of Washington, D. C., on which occasion it was sung. The discussion recorded took place at a meeting of the Petrologists' Club of Washington, the subject being Bowen's paper "Later Stages in the Evolution of Igneous Rocks" (*J. Geology*, **23** Suppl., 1–91, 1915).

(Tune: "The Flowers That Bloom in the Spring," from "The Mikado")

CHORUS:

The physico-chemical view, tra la,
Is one to which all must adhere;
For it tells you the things that are true, tra la,
And all else is wrong that you do, tra la,
And makes you feel foolish and queer.
And that's what we mean when we say unto you,—
"Stick close to the physico-chemical view."
Tra la la la la, tra la la la la, tra la, la la la la la la.

JOE IDDINGS:

The physico-chemical view, tra la,
Has nothing to do with the case;
For it gives my ideas the taboo, tra la,
That I have long preached unto you, tra la,
And should, therefore, remain in first place.
Well that's what I mean when I say unto you,—
"Oh, bother the physico-chemical view."
Tra la la la la, tra la la la la, tra la, la la la la la la.

JOHN JOHNSTON:

The physico-chemical view, tra la,
Insists on the facts as they are.
Near facts as we see them won't do, tra la,
Diffusion, affinity, too, tra la,
Can't work in an igneous stew, tra la.
Such notions are off very far.
And that's what I mean when I say unto you,—
"Stick close in the physico-chemical view."
Tra la la la la, tra la la la la, tra la, la la la la la la.

H. S. WASHINGTON, D. C.[1]:

The physico-chemical view (or whatever else you call it. Names don't matter much anyway), tra la,
Has nothing to do with the case, (perhaps it has something or other to do with some cases, but in this case it has nothing to do with the case), tra la.
My ideas on the subject may not accord with the results obtained in the Geophysical Laboratory, of which Johnston and Bowen are the—etc., exponents, etc., but I haven't much use for the laboratory anyway, although I belong to it (but that hasn't anything to do with the case either—and it's not the Quantitative Classification—I'm sick of the Quantitative Classification—yes, thoroughly sick of it); for to one who has ever seen an igneous rock it can't be forgot, tra la,
That a magma is much more complex than an artificial dry melt, and originally contains certain volatile constituents, such as, etc., that escaped while it was hot, tra la,
And therefore, you can't expect that anything so complicated and extending over hundreds of square miles, and with all these, etc., constituents is going to be governed by just the same conditions that existed when a few grams of MgO and SiO_2 were cooked in a pot, tra, la,
In the expensive suburb of Chevy Chase.
And that's what I mean when I say (if I whistled it perhaps I might make it just as clear) unto you,—
"Oh, bother the physico-chemical" (or as I was saying before I—anyway as—as I was saying call it by any other name you want to so long as you mean the same) "view."
Tra la la la la, tra la la la la, tra la, la la la la la la.

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[1] Destroyer of cigars.

THE LONDON MINERALOGICAL SOCIETY

Meeting of June 20, 1916; Dr. A. E. H. Tutton, past-president, in the chair.

Dr. J. W. Evans: *The relations between different laws of twinning giving the same twin-crystal.*

Dr. G. T. Prior: *The meteorites of Khairpur and Soko-Banja.* The Khairpur meteorite is precisely similar to the Daniels Kuil, and like it, belongs to the rare Hvittis type of chondritic stones, which contain oldhamite, and are almost free from oxide of iron. The Soko-Banja meteorite contains a small amount (4 %) of nickel-iron, very rich in nickel, together with ferro-magnesian minerals rich in ferrous iron.

Dr. G. T. Prior: *The classification of meteorites.* In chondritic stones the richer the nickel-iron in nickel the richer the ferro-magnesian minerals are in ferrous oxide, and in general the smaller the amount of nickel-iron, the richer it is in nickel. On these principles chondritic stones are divided into four groups corresponding to the types: (1) Daniels Kuil; (2) Cronstad; (3) Baroti; (4) Soko-Banja. Under the same groups the meteoric irons may be arranged according to their richness in nickel, and the non-chondritic stones according to the richness in iron of the ferro-magnesian silicates. A fifth group is added for eucrite, howardite, shergottite, angrite, and nakhlite, since they are richer in lime, ferrous oxide, and mostly also in alumina, than any chondritic stone at present known.

Lieut. A. Russell: *Note on an occurrence of gold from Cornwall.*

A. Holmes: *A series of volcanic rocks from the neighborhood of the Lucalla River, Angola.*

Prof. T. L. Walker: *Spencerite, a new zinc phosphate from British Columbia.* The new mineral occurs as the core of stalactites of hemimorphite (calamine) in the H. B. zinc mine near Salmo, in the West Kootenay district. It is snow-white in color, with brilliant pearly luster on the perfect cleavage. The three rectangular cleavages and the optical characters suggest at first sight rhombic symmetry, but complex lamellar twinning is present, and etched figures are symmetrical about one plane only. Analyses of the very pure material conform closely with the formula $Zn_3(PO_4)_2.Zn(OH)_2.3H_2O$, the mineral being a hydrated basic zinc phosphate, and thus differing from the other zinc phosphates—hopeite, parahopeite, and tarbuttite. It is named after Mr. L. J. Spencer, of the British Museum.

E. L. Bruce: *Magnesian tourmaline from Renfrew, Ontario.* Brown crystals occur at the contact between crystalline limestone and gneiss in a limestone quarry at the town of Renfrew. Analysis showed the presence of 14.53 % of magnesia.—Abstd. from *Nature,* **97,** 374, 1916.

REVIEWS AND ABSTRACTS

MINERALOGIC NOTES, SERIES 3. Waldemar T. Schaller. U. S. Geological Survey *Bull.* **610,** 164 pp., 1916.

Contents: Koechlinite (bismuth molybdate), a new mineral. Inyoite and meyerhofferite, two new calcium borates. Lucinite, a new mineral,—a dimorphous form of variscite. Schneebergite. Romeite. The natural antimonites and antimonates. Velardenite, a new member of the melilite group. The melilite group. The composition of cebollite. The crystallography of thaumasite. The chemical composition of tremolite. New occurrences of some rare minerals. Gigantic crystals of spodumene. The probable identity of mariposite and alurgite. The amblygonite group of minerals—fremontite = (natramblygonite). The crystallography of fremontite. The chemical composition of nephelite. Large crystals of bloedite. Alunite from Marysvale, Utah. The composition and relations of custerite. The composition of hodgkinsonite. Crystals of pisanite from Ducktown, Tenn. The refractive indices of strengite. The calculation of a mineral formula.

S. G. G.

CASSITERITE IN SAN DIEGO COUNTY, CALIFORNIA. Waldemar T. Schaller. U. S. Geological Survey *Bull.* **620 P,** 351–354, 1916.

Note describing an occurrence of cassiterite in the pegmatites of California, with quartz, feldspar, lepidolite, columbite and transparent blue tourmaline. S. G. G.

XANTHOPHYLLITE IN CRYSTALLINE LIMESTONE. Arthur S. Eakle. *J. Wash. Acad. Sci.,* **6** (11), 332–335, 1916.

The rare brittle mica xanthophyllite is reported as occurring at an isolated hill of crystalline marble and granodiorite situated at Crestmore, about eight miles west of Riverside, California. The xanthophyllite occurs mainly as isolated hexagonal shaped basal plates of a deep grass-green color—the variety known as valuevite [given in German form waluewite in original]—varying greatly in size, some measuring 3 to 4 cm. in diameter and 2 to 3 cm. thick. The plates are transparent with a brilliant and somewhat pearly luster, but the edges are dull, rounded and grooved. The plates are brittle with a hardness of 4–5. The thicker plates show polysynthetic twinning like the micas. The thinner crystals and cleavage plates give a good biaxial figure with an apparent optic angle of about 20°. Measurements of the optic angle in Na light showed a variation of from 12° to 18°. The optic axial plane is (100) and the mineral is optically—. The refractive indices β and γ which lie in the basal section are practically the same and were determined as 1.660. An analysis of the material showed: Sp. Gr. 3.081; SiO_2 16.74, Al_2O_3 42.70, Fe_2O_3 2.85, FeO 0.41, CaO 13.09 MgO 20.03, Ign. 4.49, sum 100.31.

Associated with the valuevite is a sky-blue calcite and monticellite of a pale brown color and somewhat greasy luster, scattered thru the calcite as small masses and grains, no crystal faces being visible. The xanthophyllite and monticellite are regarded as products of the hydrothermal metamorphism of the limestone.

S. G. G.

THE DISPERSION PHENOMENA AND THE INFLUENCE OF TEMPERATURE ON THE OPTIC AXIAL ANGLE OF SANIDINE FROM THE EIFEL. S. Kōzu. *Mineral. Mag.*, **17** (82), 237–252, 1916.

THE DISPERSION PHENOMENA OF SOME MONOCLINIC FELDSPARS. S. Kōzu. *Mineral. Mag.*, **17** (82), 253–273, 1916.

CHABAZITE AND ASSOCIATED MINERALS FROM COUNTY ANTRIM. G. F. Herbert Smith. *Mineral. Mag.*, **17** (82), 274–304, 1916.

Description of chabazite (phacolite, gmelinite), analcite, natrolite, mesolite and calcite found in the amygdaloidal basalts at Whitehead, Killyflugh, and Craigahulliar, in County Antrim, Ireland.

Dr. Smith considers chabazite and gmelinite as one species, reserving the term gmelinite for the apparently hexagonal crystals, and using phacolite in a somewhat widened sense for all crystals, invariably twinned, of rhombohedral habit.

The following are the principal forms observed: on phacolite: *r* $(10\bar{1}1)$ the most prominent form, usually striated, *e* $(01\bar{1}2)$ common, generally small, *s* $(02\bar{2}1)$ small and smooth, *a* $(11\bar{2}0)$ small, rather rare; on gmelinite: *f* $(20\bar{2}3)$ characteristic, *m* $(10\bar{1}0)$ usually striated, *c* (0001) rare. Twinning plane: of gmelinite, *r*; of phacolite, *c*. Cleavage plane: of gmelinite, *m;* of phacolite, *r*.

The following analyses were made by Dr. Prior on exceptionally pure crystalline material:

	Gmelinite		*Phacolite*		
	Whitehead		*Craigahulliar*		*Killyflugh*
SiO_2	46.64	46.75	47.81	48.61	48.82
Al_2O_3	20.04	19.79	19.73	18.06	18.53
CaO	7.00	8.25	5.01	8.19	8.81
SrO	0.22	0.23	0.02	0.60	0.26
K_2O	0.63	0.33	0.31	2.13	1.20
Na_2O	3.81	2.17	6.13	0.33	0.37
H_2O	21.84	22.09	21.56	21.68	22.09
	100.18	99.16	100.57	99.60	100.08
Sp. Gr.	2.09	2.07	2.06	2.05	2.09

There is an excess of SiO_2 and H_2O excepting in the first analysis over the usually accepted formula $(Ca,K_2,Na_2)Al_2Si_4O_{12}.6H_2O$.

The following reasons are given for supposing gmelinite to be a variety of chabazite: 1. The values of the axial ratios, whether calculated from the phacolite or gmelinite type of crystal, are the same within the limits of error of observation; 2. gmelinite is evidently rhombohedral and not hexagonal in symmetry, because the twin individuals always occur in sets of three; 3. all types of crystals may be met with between the simple rhombohedron and the complexly twinned pseudohexagonal crystals; 4. the chemical composition of gmelinite does not differ materially from that of any other type of chabazite; the principle of isomorphism will account for any difference there may be.

S. G. G.

THE NATROLITE OCCURRENCE NEAR KINBANE (WHITEHEAD), COUNTY ANTRIM. F. N. ASHCROFT. *Mineral. Mag.*, **17** (82), 305–308, 1916.

Description and analysis of natrolite, usually incorrectly labeled Giant's Causeway.

S. G. G.

PROUSTITE FROM COBALT, ONTARIO. Arthur L. Parsons. *Mineral. Mag.*, **17** (82), 309–313, 1916.

Examination of a number of crystals of proustite from Cobalt showed two types, one characterized by a rhombohedron and a prominent prism, and the second consisting of certain scalenohedral faces in addition to the above. The following forms were noted: *a* $(11\bar{2}0)$, *b* $(10\bar{1}0)$, *r* $(10\bar{1}1)$, *e* $(01\bar{1}2)$, *s* $(02\bar{2}1)$, Γ $(07\bar{7}2)$, *v*, $(21\bar{3}1)$, and y_1 $(13.7.\overline{20}.6)$ new. Axial ratio: a:c = 1:0.8015–0.8027.

Analysis of the material by H. V. Ellsworth gave: Ag 64.12, As 15.90, S 19.28, Sb 0.08, Fe 0.25, Co (including tr. of Ni) 0.12, insoluble in HNO_3 0.38 = 100.13. Deducting for pyrite, smaltite, and pyrargyrite the analysis shows a nearly pure proustite with a small excess of As.

S. G. G.

CRYSTALLOGRAPHIC RELATIONS OF ALLIED SUBSTANCES TRACED BY MEANS OF THE LAW OF VALENCY-VOLUMES. W. Barlow. *Mineral. Mag.*, **17** (82), 314–323, 1916.

DEMONSTRATION SIMPLE DE LA LOI DE MILLER. (A SIMPLE DEMONSTRATION OF MILLER'S LAW.) G. Cesáro. *Mineral. Mag.*, **17** (82), 324–325, 1916.

THE CRYSTALLOGRAPHY AND DEHYDRATION OF TORBERNITE. A. F. Hallimond. *Mineral. Mag.*, **17** (82), 326–339, 1916.

Measurements of 11 crystals of torbernite gave the following results (calculated). *c* (001), *e* (101), *o* (103, *l* (112), *m* (110). $c:l = 64°34'$, $c:o = 44°45'$, $c:e = 71°25'$, $c:m = 90°$; several vicinal faces, *u*, *w*, *q*, were also noted. The axial ratio is: a:c = 1:2.974.

The limits of temperature and vapor-pressure within which torbernite can exist are very narrow; in fact, little outside the variations which occur from day to day in the condition of the atmosphere. The change is one of dehydration, and occurs in the open air at about 130°C., the products being known as meta-torbernite I and II. Experiments showed that the alteration is marked by well-defined changes in the optical properties.

S. G. G.

CRYSTALS OF IRON PHOSPHIDE (RHABDITE) FROM A BLAST-FURNACE. L. J. SPENCER. *Mineral. Mag.*, **17** (82), 340–343, 1916.

The crystals came from a "bear" or mass of metal from a blast-furnace, and occurred sparingly in drusy cavities, being absent in the metal itself. The cavities are lined with "fir-tree crystallites" of metallic iron, and resting on these are the bright needles of iron phosphide often extending completely across the small spaces. The needles of rhabdite are tin-white in color with a brilliant metallic luster, and sometimes a yellow tarnish. They are brittle, and break with a sub-conchoidal cross fracture. The forms present on the crystals are *a* (100), *m* (110) and *o* (111); $mo = 63°52'$; the axial ratio, $a:c = 1:0.3469$. S. G. G.

A (SEVENTH) LIST OF NEW MINERAL NAMES. L. J. SPENCER. *Mineral. Mag.*, **17** (82), 344–362, 1916.

An annotated list of all mineral names which have come into use since 1913, with a systematic list of new minerals classified chemically. S. G. G.

STUDIES OF BRAZILIAN FAVAS. OLIVER C. FARRINGTON, of the Field Museum of Natural History, Chicago. *Am. J. Sci.* [4], **41** (4), 355–360, 1916.

A number of these objects, heavy-mineral pebbles obtained in diamond washings, have been analyzed and are described. One type consists of TiO_2 with 0.6% H_2O, and the new varietal name *paredrite* is suggested for it. Another lot proved to be gorceixite, another barium-bearing hamlinite, another an impure hydroxide of aluminium, and still others mixtures too complex for determination of the constituents. Favas closely resembling each other in physical characters may thus differ widely in composition. [Before the new name "*paredrite*" is accepted by mineralogists some information will have to be obtained as to whether the material is a variety of rutile, brookite, octahedrite, or a colloidal form of titanium dioxide; whether essential distinctness in physical or optical properties is shown; and whether the water is present as inclusions, is adsorbed, or is chemically combined. The paper contains no such data nor, indeed, any optical observations on the other minerals, without which the analyses are of little significance. E. T. W.

EXCHANGES OFFERED

Exchange notices will be printed free of charge to our subscribers in this column. Goods for sale must be offered in the advertising columns.

W. Scott Lewis, 3493 Eagle St., Los Angeles, Cal. Desert jasper, chalcedony (fine for cutting); rare forms of petrified wood, asphaltum from La Brea fossil beds; shell limestone; biotite, and miscellaneous common minerals.

Wm. H. Broadwell, 571 Hawthorne Ave., Newark, N. J. New Jersey zeolites (Apophyllite, laumontite, natrolite, pectolite, prehnite, etc.); thaumasite, babingtonite; rhodonite, franklinite, zincite, etc. List sent upon application.

W. G. Levison, 1435 Pacific St., Brooklyn, N. Y., will exchange fine specimens of New Jersey minerals or some duplicate numbers of the Mineral Collector, for any parts of the Proceedings of the Lyceum of Natural History of N. Y., Series 1 and 2, or any parts of Vols. 1, 2 and 3 of the Annals of the N. Y. Acad. of Sciences.

Edwin A. Turner, 1696 Green St., San Francisco, Cal. Jasper, green chert, cinnabar, kinradeite (spherulite jasper) chalcedony from Culebra Cut, Panama; opalized wood from Nevada; beach stones of various colors.

J. P. Wintringham, 153 Henry St., Brooklyn, N. Y. Wanted: triclinic, monoclinic, or orthorhombic crystals for crystallographic measurement or for sections; pericline twins—single or polysynthetic or plagioclases of known composition. Please state what is wanted in return.

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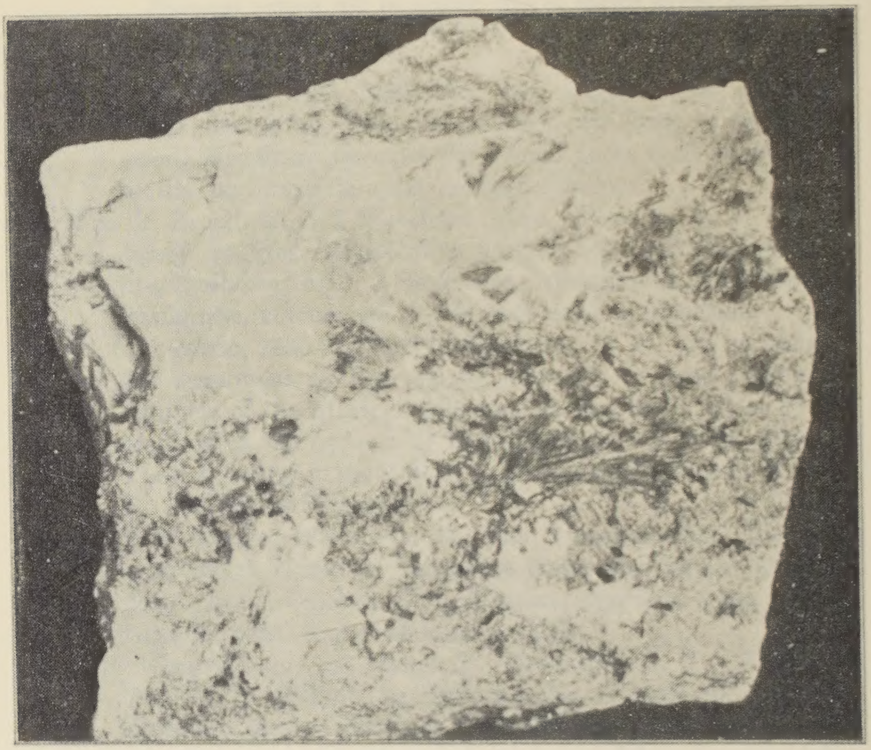

Photograph by Samuel G. Gordon

LAMELLAR CALCITE (ARGENTINE) WITH MESOLITE (WHITE RADIATIONS) AND STILBITE (DARK RADIATIONS), WARD'S QUARRY, DELAWARE CO., PA. NATURAL SIZE.

PLATE IV.